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THE *GEOMYDOECUS OREGONUS* COMPLEX (MALLOPHAGA: TRICHODECTIDAE) OF THE WESTERN UNITED STATES POCKET GOPHERS (RODENTIA: GEOMYIDAE)[1]

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Abstract.—Four species of the *Geomydoecus oregonus* complex are described and illustrated: *G. oregonus* Price and Emerson from *Thomomys bulbivorus* (Richardson); *G. idahoensis* Price and Emerson from the seven recognized subspecies of *T. townsendii* (Bachman); *G.* **shastensis** new species from 12 subspecies of *T. bottae* (Eydoux and Gervais) (type-host: *T. b. leucodon* Merriam); and *G.* **hueyi** new species from 9 subspecies of *T. bottae* (type-host: *T. b. pallescens* Rhoads). Distinctions between these taxa are shown using qualitative and quantitative characters and principal components analysis of quantitative characters. A discriminant function is provided for the separation of females of *G. hueyi* and *G. shastensis*. Keys are given for the identification of these four taxa.

Price and Emerson (1971), in a revision of the genus *Geomydoecus* Ewing, 1929, recognized *G. oregonus oregonus* Price and Emerson from *Thomomys bulbivorus* (Richardson) in western Oregon and *G. o. idahoensis* Price and Emerson from four subspecies of *T. townsendii* (Bachman) in Idaho and Nevada. Extensive collecting since then from many additional individuals of *Thomomys* in the western United States has shown members of the *oregonus* complex to occur not only on *T. bulbivorus* and all seven recognized subspecies of *T. townsendii* but also on 21 subspecies of *T. bottae* (Eydoux and Gervais) from California and Oregon. This abundance of material has allowed a thorough re-examination of the *oregonus* complex and has resulted in the recognition of a total of four specific taxa. It is our

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purpose here to describe and illustrate these taxa and to provide keys for their identification.

Quantitative data for lice of the *oregonus* complex combined with their host and locality information are included as part of a computerized pocket gopher louse data base maintained at the University of Minnesota. The retrieval and analysis of these data were performed with an integrated group of computer programs developed by the authors and called the BUG system. A description and explanation of our data handling and analysis procedures may be found in Price and Hellenthal (1979).

In the following descriptions, measured or counted characters are followed by the minimum and maximum observed values and the sample size, mean, and standard deviation in parentheses. All measurements are in millimeters. Illustrations are for specimens from the type-host. In evaluating character usefulness for specific discrimination, critical values for each character were calculated at the point where the likelihood of single character misidentification of the two compared taxa was equal, given normality and equal variance, and ignoring probability of collection. For characters offering moderately good discriminating ability, these critical values and the corresponding probabilities of misidentification are given. In an abbreviated comparative description for a species, quantitative data are given only for those characters whose means differ at a significance level of $P \leq 0.01$. In the "Material examined" section, a number in parentheses following a locality represents the total gophers from which lice were taken. Original locality data expressed in miles are followed parenthetically by the metric equivalent to 0.1 km; the English figure, rather than the metric, expresses the precision of the location estimate.

The discriminant functions given in this paper were calculated using the U.C.L.A. BMD computer program BMD04M (Discriminant Analysis for Two Groups), as described in Dixon (1973). The principal components analysis used a computer program adapted from program PCFLOR in Goldstein and Grigal (1972).

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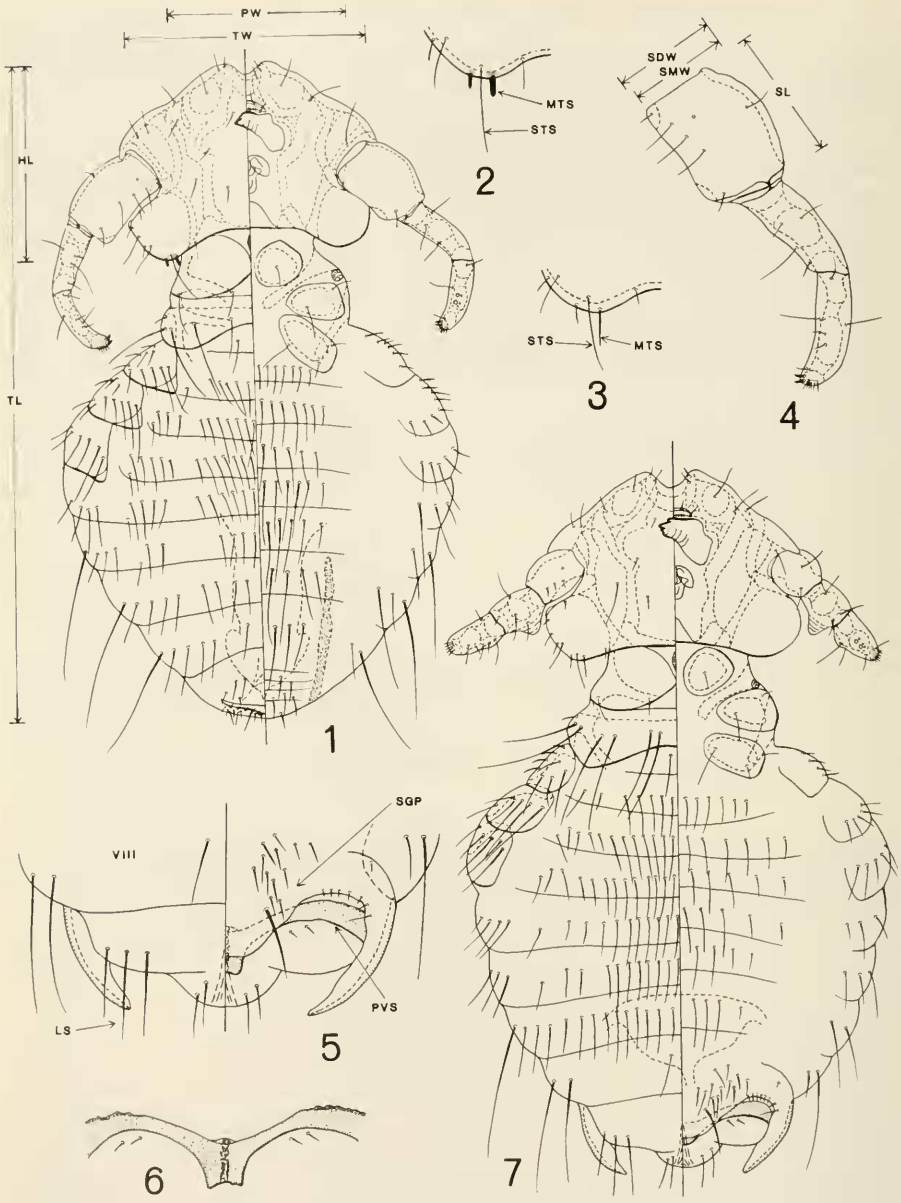
Geomydoecus oregonus Price and Emerson, NEW STATUS
Figs. 1–8, 12, 16

Geomydoecus oregonus oregonus Price and Emerson, 1971: 243.

Type-host: *Thomomys bulbivorus* (Richardson).

Male.—As in Fig. 1. Temple width (TW) 0.445–0.485 (26: 0.460 ± 0.0087); head length (HL) 0.320–0.370 (26: 0.342 ± 0.0131); submarginal and inner marginal temple setae (STS, MTS: Fig. 2) 0.080–0.100 (16: 0.091 ± 0.0055) and 0.025–0.030 (24: 0.026 ± 0.0025) long, respectively, with STS lateroanterior to inner MTS; both inner and outer MTS blunt, spiniform. Antenna (Fig. 4) with scape length (SL) 0.165–0.185 (22: 0.176 ± 0.0062), scape medial width (SMW) 0.110–0.130 (22: 0.121. ± 0.0053), scape distal width (SDW) 0.115–0.135 (22: 0.126 ± 0.0054). Prothorax width (PW) 0.320–0.370 (26: 0.338 ± 0.0120). Tergal setae: I, 2; II, 9–14 (26: 11.4 ± 1.06); III, 17–22 (22: 19.1 ± 1.46); IV, 19–27 (23: 23.0 ± 2.33); V, 18–26 (22: 21.4 ± 2.02); VI, 11–19 (25: 14.7 ± 1.80); tergal and pleural setae on VII, 16–24 (25: 20.9 ± 2.18). Sternal setae: II, 10–15 (24: 12.6 ± 1.35); III, 9–16 (24: 12.0 ± 1.60); IV, 8–16 (23: 12.8 ± 1.67); V, 8–14 (23: 10.4 ± 1.73); VI, 7–11 (25: 9.4 ± 1.11); VII, 4–10 (26: 7.7 ± 1.40); VIII, 5–7 (26: 6.1 ± 0.48). Total length (TL) 1.205–1.490 (26: 1.391 ± 0.0714). Genitalia as in Fig. 8; sac having 6 large spines (GSS), with outer pair deeply indented anteriorly (Fig. 12) and close to medioanterior pair; parameral arch (PA) with lateroposterior expanded portion, width (PAW) 0.155–0.180 (26: 0.163 ± 0.0055); endomeral plate (EP) roughly triangular, with distinct apical division, width (EPW) 0.085–0.100 (26: 0.092 ± 0.0037), length (EPL) 0.090–0.105 (26: 0.096 ± 0.0044).

Female.—As in Fig. 7. Temple width 0.465–0.510 (31: 0.485 ± 0.0111); head length 0.295–0.370 (31: 0.330 ± 0.0170); submarginal and inner marginal temple setae (STS, MTS: Fig. 3) 0.070–0.090 (23: 0.081 ± 0.0052) and 0.040–0.060 (29: 0.046 ± 0.0040) long, respectively, with STS lateroanterior to inner MTS. Prothorax width 0.330–0.360 (31: 0.347 ± 0.0088). Tergal setae: I, 2; II, 13–19 (30: 16.3 ± 1.42); III, 19–27 (31: 22.5 ± 2.03); IV, 22–31 (30: 27.0 ± 2.25); V, 21–31 (30: 25.2 ± 1.97); VI, 16–26 (31: 21.7 ± 2.38); tergal and pleural setae on VII, 30–40 (30: 34.6 ± 2.60). Longest seta of medial 10 on tergite VI, 0.075–0.100 (30: 0.089 ± 0.0054); on tergite VII, 0.080–0.110 (28: 0.098 ± 0.0064), with 0–3 (27: 0.3 ± 0.78) of these longer than 0.100. Longest seta of medial pair on tergite VIII, 0.050–0.090 (29: 0.071 ± 0.0082). Last tergite with 3 lateral setae (LS: Fig. 5) close together on each side; outer seta generally shorter, 0.060–0.100 (17: 0.082 ± 0.0110) long, and middle and inner setae subequal in length 0.080–0.115 (22: 0.101 ± 0.0076) and 0.085–0.120 (28: 0.102 ± 0.0065) long, respectively. Sternal setae: II, 9–14 (28: 12.0 ± 1.48); III, 10–13 (29: 11.7 ± 0.72); IV, 8–13 (26: 10.9 ± 1.40); V, 6–13 (24: 9.9 ± 1.69); VI, 7–11 (28: 9.4 ± 0.87);



Figs. 1–7. *Geomydoecus oregonus*. 1, Male. 2, Male temple margin. 3, Female temple margin. 4, Male dorsal antenna. 5, Female terminalia. 6, Female postvulval sclerite. 7, Female.

VII, 7–11 (30: 9.0 ± 0.87). Subgenital plate (SGP: Fig. 5) with 19–28 (30: 24.2 ± 2.71) setae, with distribution and lengths as shown, with 1 seta on each side distinctly longer and thicker than others. Total length 1.150–1.500 (31: 1.290 ± 0.0752). Postvulval sclerite (PVS: Fig. 5) as in Fig. 6, with 2 subequal short setae on each side. Genital sac as in Fig. 16, width (GSW) 0.230–0.275 (31: 0.253 ± 0.0115), length (GSL) 0.160–0.240 (31: 0.195 ± 0.0215), with 6–10 (30: 8.0 ± 1.40) flattened smooth loops across anterior portion, posteriormost loop situated 0.060–0.120 (30: 0.081 ± 0.0143) back from anterior sac margin.

Discussion.—The best qualitative feature for recognizing *G. oregonus* from other members of the complex is the shape and placement of the outer pair of male genital sac spines. For males, the best quantitative characters and their critical values for discrimination and probabilities of misidentification were the temple width 0.433 (0.021), the width of the endomeral plate 0.086 (0.054), and the prothorax width 0.318 (0.061). For females, the best characters were the temple width 0.462 (0.068) and the number of setae on the subgenital plate 21.68 (0.127).

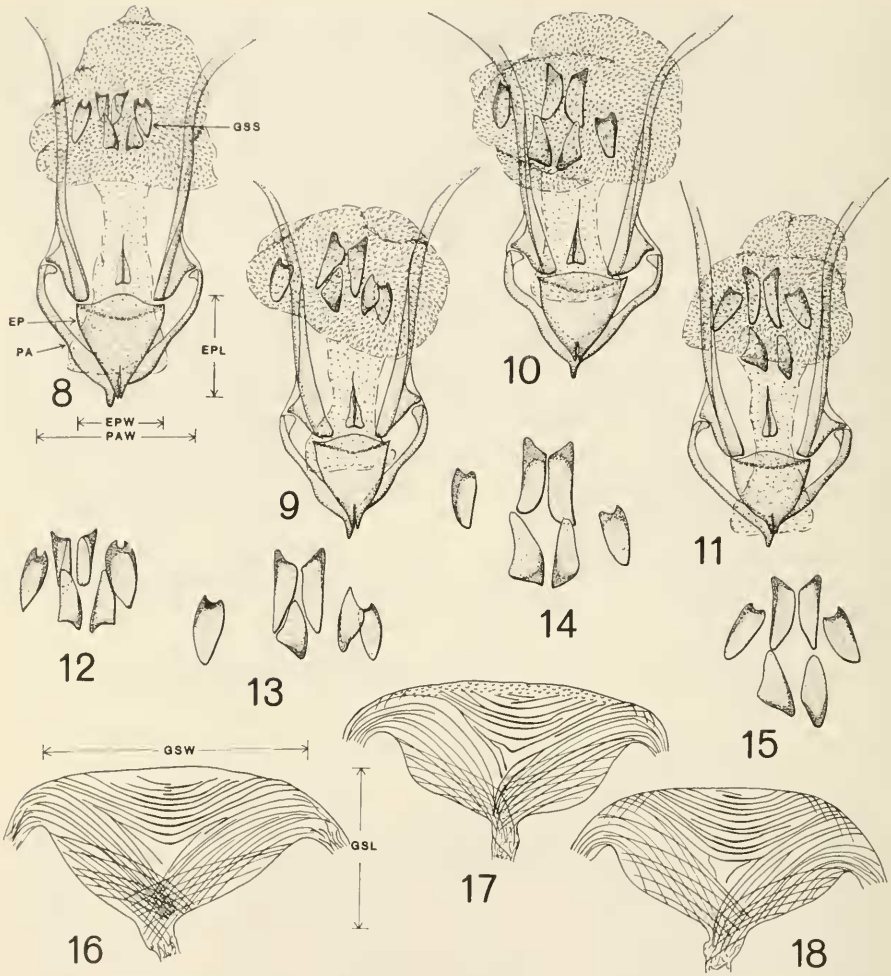
Material examined.—46 ♂, 38 ♀, *T. bulbivorus*, Oregon, Washington Co., Hillsboro (3); Benton Co., Corvallis (1), Granger (1); Multnomah Co., Portland (3); Yamhill Co., McMinnville (1).

Geomydoecus idahoensis Price and Emerson, NEW STATUS
Figs. 9, 13

Geomydoecus oregonus idahoensis Price and Emerson, 1971: 245.

Type-host: *Thomomys townsendii townsendii* (Bachman).

Male.—Much as for *G. oregonus*, except as follows. Temple width 0.390–0.450 (111: 0.411 ± 0.0114); head length 0.285–0.340 (111: 0.305 ± 0.0122). Antenna with scape length 0.150–0.180 (108: 0.161 ± 0.0057), scape medial width 0.095–0.135 (109: 0.111 ± 0.0061), scape distal width 0.095–0.140 (109: 0.116 ± 0.0066). Prothorax width 0.270–0.330 (113: 0.298 ± 0.0105). Tergal setae: II, 11–17 (113: 13.5 ± 1.34); III, 17–25 (111: 21.3 ± 1.72); IV, 20–30 (108: 24.6 ± 2.02); V, 17– 28 (110: 22.9 ± 2.11); VI, 13–20 (112: 16.7 ± 1.41). Sternal setae: II, 11–17 (112: 13.6 ± 1.32); III, 10–18 (112: 13.0 ± 1.42); IV, 10–18 (112: 13.7 ± 1.40); V, 8–16 (109: 11.3 ± 1.39); VI, 8–14 (114: 10.4 ± 1.09). Total length 1.090–1.400 (108: 1.273 ± 0.0638). Genitalia as in Fig. 9; sac spines as in Fig. 13, with outer pair not so deeply indented anteriorly and situated more lateroposterior to median pair; parameral arch width 0.140–0.170 (113: 0.152 ± 0.0055); endomeral plate more tapered medioposteriorly, width 0.070–0.090 (113: 0.080 ± 0.0039), length 0.070–0.100 (110: 0.083 ± 0.0052).



Figs. 8–11. Male genitalia. 8, *Geomydoecus oregonus*. 9, *G. idahoensis*. 10, *G. shastensis*. 11, *G. hueyi*. Figs. 12–15. Male genital sac spines. 12, *G. oregonus*. 13, *G. idahoensis*. 14, *G. shastensis*. 15, *G. hueyi*. Figs. 16–18. Female genital sac. 16, *G. oregonus*. 17, *G. shastensis*. 18, *G. hueyi*.

Female.—Much as for *G. oregonus*, except as follows. Temple width 0.415–0.465 (108: 0.445 ± 0.0117); head length 0.275–0.335 (108: 0.303 ± 0.0135). Inner marginal temple seta 0.025–0.055 (105: 0.041 ± 0.0045) long. Prothorax width 0.280–0.345 (113: 0.317 ± 0.0134). Tergal setae: II, 14–22 (111: 18.0 ± 1.70); III, 19–29 (112: 24.4 ± 1.92); V, 19–29 (111: 23.6 ± 2.26). Longest seta of medial 10 on tergite VII, 0.070–0.100 (107: 0.089 ± 0.0063),

with 0 of these longer than 0.100. Outer of 3 lateral setae on each side of last tergite generally shorter, 0.045–0.095 (80: 0.071 ± 0.0088) long, with middle and inner setae 0.065–0.100 (87: 0.082 ± 0.0080) and 0.065–0.105 (90: 0.088 ± 0.0083) long, respectively. Sternal setae: II, 11–18 (113: 13.5 ± 1.43); IV, 9–15 (109: 12.4 ± 1.16); V, 7–14 (110: 10.8 ± 1.29); VI, 7–13 (112: 10.4 ± 1.12); VII, 8–12 (112: 9.6 ± 0.89). Subgenital plate with 13–26 (113: 20.3 ± 2.22) setae. Total length 1.020–1.370 (108: 1.215 ± 0.0724). Genital sac width 0.190–0.280 (113: 0.243 ± 0.0163), length 0.135–0.210 (111: 0.174 ± 0.0180), with posteriormost loop situated 0.040–0.090 (110: 0.063 ± 0.0095) back from anterior sac margin.

Discussion.—Both sexes of *G. idahoensis* are close to those of *G. oregonus*, but several qualitative and quantitative features enable separation. The shape and lateroposterior placement of the outer spines of the genital sac (Fig. 13) facilitate recognition of the male. For males, the best quantitative characters and their critical values for discrimination and probabilities of misidentification were the temple width 0.436 (0.013), the prothorax width 0.318 (0.031), and the width of the endomeral plate 0.086 (0.065). For females, the best characters were the temple width 0.465 (0.043), the length of the middle seta on the last tergite 0.092 (0.114), and the prothorax width 0.332 (0.121).

Although *G. idahoensis* was originally described by Price and Emerson (1971) as a subspecies of *G. oregonus*, sufficient character differences are now known to justify its being elevated to specific status. The host distribution of *G. idahoensis* is on all seven of the recognized subspecies of *T. townsendii* occurring in Idaho, Nevada, Oregon, and northern California.

Material examined.—43 ♂, 41 ♀, *T. t. townsendii*, Idaho, Ada Co., Cloverdale (3), Boise (1); Canyon Co., Parma, Branch Exp. Sta. (1), Nampa (2). Oregon, Malheur Co., Vale (2), no locality (2). 46 ♂, 23 ♀, *T. t. bachmani* Davis, Oregon, Harney Co., Fields (1), S end Lake Alvord (1), 5 mi (8.0 km) SW Narrows (1). Nevada, Humboldt Co., 1 mi (1.6 km) N Winnemucca (1), 18 mi (29.0 km) NE Iron Point (2); Pershing Co., 3.3 mi (5.3 km) SW Lovelock (1). 36 ♂, 13 ♀, *T. t. elkoensis* Davis, Nevada, Elko Co., 3 mi (4.8 km) S (1) and 2 mi (3.2 km) W (1) Halleck; Eureka Co., Evans (1), Diamond Valley, 4 mi (6.4 km) S Romano (1). 12 ♂, 3 ♀, *T. t. nevadensis* Merriam, Nevada, Lander Co., Malloy Ranch, 5 mi (8.0 km) W Austin (3), Jct 50 at Reese River, 10 mi (16.1 km) W Austin (1). 10 ♂, 11 ♀, *T. t. owyhensis* Davis, Idaho, Owyhee Co., Castle Creek, 8 mi (12.9 km) S Oreana (2). 70 ♂, 54 ♀, *T. t. relictus* Grinnell, California, Lassen Co., 1.8 mi (2.9 km) S, 1.6 mi (2.6 km) W (1), 5.0 mi (8.0 km) W, 1.5 mi (2.4 km) S (1), 2.4 mi (3.9 km) S, 1.5 mi (2.4 km) W (7), and 3.0 mi (4.8 km) S, 1.7 mi (2.7 km) W (2) Herlong, 7 mi (11.3 km) W Wendel (2), 3 mi (4.8 km) S (2) and 4.5 mi (7.2 km) ENE (1) Susanville, 5 mi (8.0 km) W Standish (1),

Honey Lake (1). 36 ♂, 18 ♀, *T. t. similis* Davis, Idaho, Bannock Co., 4 mi (6.4 km) NW (1), 10 mi (16.1 km) N (1), and at (1) Pocatello; Bingham Co., 1 mi (1.6 km) E Pingree (1); Power Co., 4 mi (6.4 km) NW American Falls (1).

Geomydoecus shastensis Price and Hellenthal, NEW SPECIES
Figs. 10, 14, 17

Type-host.—*Thomomys bottae leucodon* Merriam.

Male.—Much as in Fig. 1. Temple width 0.370–0.430 (134: 0.401 ± 0.0133); head length 0.270–0.350 (136: 0.312 ± 0.0153); submarginal and inner marginal temple setae 0.075–0.115 (95: 0.092 ± 0.0078) and 0.020–0.030 (133: 0.025 ± 0.0029) long, respectively. Antenna with scape length 0.140–0.180 (131: 0.156 ± 0.0081), scape medial width 0.090–0.120 (130: 0.104 ± 0.0062), scape distal width 0.090–0.125 (131: 0.108 ± 0.0068). Prothorax width 0.255–0.325 (141: 0.293 ± 0.0134). Tergal setae: II, 10–16 (140: 12.9 ± 1.45); III, 13–24 (141: 19.6 ± 1.92); IV, 18–28 (141: 23.0 ± 2.27); V, 17–27 (141: 21.1 ± 2.16); VI, 11–21 (140: 16.4 ± 1.88); tergal and pleural setae on VII, 17–28 (142: 23.1 ± 2.11). Sternal setae: II, 10–20 (143: 14.9 ± 1.84); III, 11–22 (143: 16.5 ± 2.11); IV, 11–20 (141: 16.1 ± 1.98); V, 8–18 (140: 12.7 ± 1.64); VI, 8–15 (141: 11.3 ± 1.28); VII, 5–11 (142: 7.9 ± 1.28); VIII, 5–9 (141: 6.3 ± 0.72). Total length 1.085–1.475 (134: 1.307 ± 0.0762). Genitalia as in Fig. 10; outer pair of sac spines with relatively shallow anterior indentation, asymmetrically aligned with spine on one side recessed posterior to that on other side (Fig. 14); parameral arch width 0.135–0.170 (140: 0.148 ± 0.0075); endomeral plate width 0.070–0.085 (141: 0.079 ± 0.0042), length 0.060–0.095 (140: 0.081 ± 0.0053).

Female.—Much as in Fig. 7. Temple width 0.390–0.480 (162: 0.434 ± 0.0166); head length 0.280–0.345 (162: 0.312 ± 0.0130); submarginal and inner marginal temple setae 0.065–0.100 (112: 0.084 ± 0.0070) and 0.035–0.055 (156: 0.044 ± 0.0045) long, respectively. Prothorax width 0.290–0.365 (172: 0.319 ± 0.0143). Tergal setae: II, 13–23 (171: 17.5 ± 1.79); III, 18–30 (171: 23.5 ± 2.32); IV, 21–35 (171: 26.5 ± 2.41); V, 18–30 (172: 24.0 ± 2.44); VI, 16–31 (171: 22.8 ± 2.47); tergal and pleural setae on VII, 27–43 (172: 35.8 ± 2.81). Longest seta of medial 10 on tergite VI, 0.070–0.110 (169: 0.090 ± 0.0070); on tergite VII, 0.075–0.110 (165: 0.092 ± 0.0073), with 0–4 (165: 0.1 ± 0.52) of these longer than 0.100. Longest seta of medial pair on tergite VIII, 0.055–0.095 (157: 0.076 ± 0.0081). Lateral setae of last tergite with outer seta generally shorter, 0.050–0.095 (118: 0.069 ± 0.0083) long, and middle and inner setae subequal in length, 0.060–0.100 (136: 0.083 ± 0.0078) and 0.065–0.110 (137: 0.087 ± 0.0077) long, respectively. Sternal setae: II, 11–20 (171: 15.5 ± 1.93); III, 11–21 (171: 16.9 ± 2.30); IV, 11–21 (166: 16.3 ± 1.92); V, 8–16 (169: 12.7 ± 1.48); VI, 8–15 (169: 11.3 ± 1.26); VII, 7–13 (171: 9.9 ± 1.08). Subgenital plate with 13–24 (172: 18.6

± 2.05) setae. Total length 1.105–1.435 (161: 1.254 ± 0.0679). Genital sac often as in Fig. 17, width 0.200–0.285 (170: 0.235 ± 0.0150), length 0.145–0.220 (168: 0.178 ± 0.0155), with 4–11 (169: 7.0 ± 1.34) flattened loops across anterior portion, posteriormost loop situated 0.040–0.090 (169: 0.066 ± 0.0100) back from anterior sac margin; narrow portion of sac anterior to lines often with light pocking, as in Fig. 17.

Discussion.—While *G. shastensis* is very close to *G. idahoensis*, the former is recognizable qualitatively by its male having an asymmetrical placement of the outer genital sac spines and its female often having a faint pocking on a narrow portion of the genital sac anterior to the transverse lines. Quantitative differences between these taxa are slight. For males, the best quantitative character and its critical value for discrimination and probability of misidentification were the number of setae on sternite III 14.72 (0.173). For females, the best characters were the number of setae on sternite III 14.55 (0.113) and on sternite IV 14.38 (0.119).

Material examined.—Holotype: ♂, *T. b. leucodon* (University of California Museum of Vertebrate Zoology-122561), 1 mi (1.6 km) N Cassel, Shasta Co., California, 23.VI.1958, S. B. Benson; in collection of University of Minnesota. Paratypes: 76 ♂, 73 ♀, *T. b. leucodon*, California, Shasta Co., 1 mi (1.6 km) N Cassel (1), NNW Old Fort Crook (1); Glenn Co., 6 mi (9.7 km) E Orland (1); Lake Co., Lower Lake (1); Lassen Co., 4.4 mi (7.1 km) S, 0.8 mi (1.3 km) W Adin (1); Modoc Co., Pit River Ranger Station (2), 1.75 mi (2.8 km) N Canby (1), 3 mi (4.8 km) S, 0.1 mi (0.2 km) W Brown's Well (1); Placer Co., 0.5 mi (0.8 km) NE Dutch Flat (1); Siskiyou Co., Shasta River, 3 mi (4.8 km) S Edgewood (1); Tehama Co., Lyman, 4 mi (6.4 km) NW Lyonsville (1). Oregon, Jackson Co., 4 mi (6.4 km) E Medford (1), Big Applegate River, 1 mi (1.6 km) S mouth Beaver Creek (1); Josephine Co., N side Rogue River, 2 mi (3.2 km) W Grants Pass (1). Other specimens: 21 ♂, 19 ♀, *T. b. acrirostratus* Grinnell, California, Humboldt Co., Horse Mt. (1); Lake Co., near Middletown (1), near Kelseyville (1); Mendocino Co., Mt. Sanhedrin (1), Hopland Field Sta., 3 mi (4.8 km) NE Hopland (1); Trinity Co., Wildwood (1), Peanut (1), Forest Glen (1), Trinity Mts., Helena (2). 37 ♂, 57 ♀, *T. b. agricolaris* Grinnell, California, Napa Co., 5 mi (8.0 km) SW Napa (1), Las Posadas Camp, 2 mi (3.2 km) SE Angwin (1); Solano Co., 2.5 mi (4.0 km) SE Winters (1), 2 mi (3.2 km) E intersection Monticello & Winters Rd. (1), N end Potrero Hills (1); Yolo Co., Davis (1), Straloch Farm, 3 mi (4.8 km) W Davis (1). 3 ♂, 3 ♀, *T. b. awahnee* Merriam, California, Mariposa Co., Yosemite Valley (2), foot Yosemite Falls (2). 13 ♂, 11 ♀, *T. b. detumidus* Grinnell, Oregon, Curry Co., 1.5 mi (2.4 km) S Pistol River (3). 2 ♂, 1 ♀, *T. b. diaboli* Grinnell, California, Fresno Co., 8 mi (12.9 km) W Coalinga (1); Merced Co., Herrero Canyon, 22 mi (35.4 km) WSW Los Banos (2). 26 ♂, 21 ♀, *T. b. laticeps* Baird, California, Del Norte Co., Smith River (1), Fort Dick (1), Requa (1); Hum-

boldt Co., Arcata (1), Trinidad (1), Oregon, Curry Co., State Line (1). 46 ♂, 37 ♀, *T. b. mewa* Merriam, California, Calaveras Co., Wallace (2); El Dorado Co., 1 mi (1.6 km) NW (1) and at (1) Fyffe; Amador Co., 5 mi (8.0 km) E Carbondale (2); Fresno Co., 1 mi (1.6 km) S Dunlap (1); Mariposa Co., 3 mi (4.8 km) NE Coulterville (1); Placer Co., Applegate (2); Plumas Co., Quincy (1); Stanislaus Co., N side River, Knights Ferry (1); Tuolumne Co., near Hetch Hetchy Dam (2). 15 ♂, 22 ♀, *T. b. minor* V. Bailey, California, Humboldt Co., Cuddeback (1), Capetown (1), 0.5 mi (0.8 km) E Shelter Cove (2), 1 mi (1.6 km) SW Ferndale (2), Carlotta (2); Marin Co., Dillon Beach (1); Mendocino Co., 2 mi (3.2 km) S Gualala (2), Fort Bragg (4). 13 ♂, 12 ♀, *T. b. navus* Merriam, California, Butte Co., Butte Creek, 4 mi (6.4 km) SE Chico (1), 9 mi (14.5 km) S, 6 mi (9.7 km) W Chico (1); Colusa Co., Sites (1); Sutter Co., Rio Oso, Sacramento Valley (2), Marysville Butte, 3 mi (4.8 km) NW Sutter (1); Tehama Co., Red Bluff (1). 2 ♂, 15 ♀, *T. b. saxatilis* Grinnell, California, Lassen Co., Gold Run Creek, 4.0 mi (6.4 km) S, 1.3 mi (2.1 km) W (3) and 4.1 mi (6.6 km) S, 1.9 mi (3.1 km) W (2) Susanville. 6 ♂, 8 ♀, *T. b. silvifugus* Grinnell, California, Humboldt Co., Coyote Peak (3).

Geomydoecus hueyi Price and Hellenthal, NEW SPECIES
Figs. 11, 15, 18

Type-host.—*Thomomys bottae pallescens* Rhoads.

Male.—Much as for *G. shastensis*, except as follows. Temple width 0.380–0.445 (101: 0.409 ± 0.0129). Antenna with scape length 0.145–0.180 (96: 0.160 ± 0.0080), scape medial width 0.095–0.120 (95: 0.107 ± 0.0067), scape distal width 0.095–0.125 (94: 0.111 ± 0.0069). Prothorax width 0.275–0.340 (102: 0.304 ± 0.0136). Tergal setae: II, 11–17 (99: 14.1 ± 1.32); III, 17–26 (99: 20.8 ± 1.73); IV, 18–30 (99: 23.8 ± 2.12); V, 17–30 (99: 22.6 ± 2.34); tergal and pleural setae on VII, 16–27 (100: 21.9 ± 1.93). Sternal setae: V, 11–16 (100: 13.5 ± 1.03); VI, 10–15 (101: 12.5 ± 1.05); VII, 7–12 (101: 9.6 ± 0.99). Genitalia as in Fig. 11; outer pair of sac spines arranged symmetrically around medioanterior pair (Fig. 15), much as for *G. oregonus*, but each not so deeply indented anteriorly; parameral arch width 0.140–0.170 (98: 0.152 ± 0.0063), with little expansion of lateroposterior portion; endomeral plate with narrowed medioposterior portion.

Female.—Much as for *G. shastensis*, except as follows. Temple width 0.415–0.480 (104: 0.441 ± 0.0152); head length 0.275–0.350 (104: 0.306 ± 0.0140); inner marginal temple seta 0.030–0.060 (104: 0.039 ± 0.0047) long. Tergal setae: IV, 22–35 (106: 27.7 ± 2.59); V, 19–32 (103: 25.4 ± 2.67). Longest seta of medial pair on tergite VIII, 0.050–0.090 (101: 0.073 ± 0.0090). Sternal setae: V, 11–18 (102: 13.3 ± 1.14); VI, 9–15 (105: 12.7 ± 1.02); VII, 8–14 (107: 11.8 ± 1.04). Genital sac much as in Fig. 18, width 0.200–0.295 (108: 0.253 ± 0.0171), length 0.140–0.240 (107: 0.186 ± 0.0186),

with 7–16 (106: 11.1 ± 1.82) flattened loops across anterior portion often extending to anterior margin of sac, posteriormost loop situated 0.060–0.115 (106: 0.089 ± 0.0114) back from anterior margin.

Discussion.—The male of *G. hueyi* is separable qualitatively from *G. shastensis*, as well as those of the other species of the complex, by the alignment and shape of the outer pair of genital sac spines in conjunction with the shape of the parameral arch and endomeral plate. While also close to *G. shastensis*, the female of *G. hueyi* often shows the genital sac with the transverse lines extending to the anterior margin and without a narrow pocked area anterior to these lines.

For females of *G. hueyi* and *G. shastensis*, the best quantitative characters and their critical values for discrimination and probabilities of misidentification were the number of transverse lines on the genital sac 9.06 (0.094), the distance of the posteriormost of these lines from the anterior sac margin 0.077 (0.137), and the number of setae on sternite VII 10.84 (0.194). Because of the high probability of error using any one of these quantitative characters, discriminant functions were calculated using these three and each combination of two of these three characters. An explanation of the use of discriminant functions for louse identification is given in Price and Hellenthal (1975). The use of the number of transverse genital sac lines and the number of setae on sternite VII in combination provided a probability of misidentification of 0.054, with respective discriminant function coefficients of 0.0066 and 0.0068 and a critical value for the discriminant of 0.133 (discriminant means and standard deviations for *G. hueyi* were 0.152 ± 0.0145 and for *G. shastensis* 0.113 ± 0.0104). We could find no good quantitative differences between the males of these two species.

For females of *G. hueyi* and *G. idahoensis*, the best quantitative characters were the number of setae on sternite III 14.56 (0.052), the number of setae on sternite IV 14.48 (0.078), and the distance of the posteriormost line from the anterior margin of the genital sac 0.076 (0.110). For males of these two species, the best were the number of setae on sternite III 14.70 (0.122) and on sternite VI 11.45 (0.161).

Material examined.—Holotype: ♂, *T. b. pallescens* (San Diego Natural History Museum-7070), Grapeland, San Bernardino Co., California, 23.X.1928, L. M. Huey; in collection of the San Diego Natural History Museum. Paratypes: 49 ♂, 43 ♀, *T. b. pallescens*, California, San Bernardino Co., Grapeland (4); Orange Co., San Juan Creek, 8.5 mi (13.7 km) NE Capistrano (2); Riverside Co., 2 mi (3.2 km) E Ethanac (2). Other specimens: 14 ♂, 5 ♀, *T. b. altivallis* Rhoads, California, San Bernardino Co., 8 mi (12.9 km) SSE Hesperia (1), 14 mi (22.5 km) SW Hesperia toward Lake Arrowhead on toll road (1). 10 ♂, 12 ♀, *T. b. angularis* Merriam, California, Kings Co., 3 mi (4.8 km) S (2) and 6 mi (9.7 km) SE (3) Avenal; Merced Co., 0.5 mi (0.8 km) W San Luis Ranch (1); Santa Clara Co., Pacheco Pass,

Fifield Ranch (1), Gilroy (1). 34 ♂, 35 ♀, *T. b. argusensis* Huey, California, Inyo Co., Junction Ranch, Argus Mts. (4), 0.5 mi (0.8 km) SW Junction Ranch, 16 mi (25.7 km) SSE Darwin (3). 15 ♂, 9 ♀, *T. b. bottae*, California, Los Angeles Co., Highland Park (1), Pasadena (1); San Luis Obispo Co., San Simeon (1); Santa Barbara Co., 9 mi (14.5 km) ENE Santa Maria (1). 28 ♂, 31 ♀, *T. b. nigricans* Rhoads, California, San Diego Co., La Mesa (2), Witch Creek (2), Laguna Mts. (1). 6 ♂, 7 ♀, *T. b. pascalis* Merriam, California, Kern Co., 8 mi (12.9 km) S Arvin (1). 4 ♂, 3 ♀, *T. b. perpes* Merriam, California, Kern Co., Fay Creek, 6 mi (9.7 km) N Weldon (3). 49 ♂, 33 ♀, *T. b. scapterus* Elliot, California, Inyo Co., Hanaupah Canyon, Panamint Mts. (3), 3 mi (4.8 km) E Jackass Spring, Panamint Mts. (3).

Although the taxa included in the *oregonus* complex generally demonstrated sufficient character differences to enable their separation, even the best quantitative characters showed some overlap. However, this is not unexpected given the individual variability and moderate sample sizes. Because of this variability, we felt it desirable to find further supporting evidence for recognition of taxa. Principal components analysis of pooled quantitative data offers added support for our separations. Using the centered R-technique as described by Orloci (1967) for 10 characters each for males and females, the first three components were found to account for 78% of the male variation and 73% of the female variation. Scattergrams with coordinates representing the first and second principal axes in reduced character space for each sex generally supported our separation of taxa, with better grouping shown for females (Fig. 19). It will be noted from this that *G. oregonus* from *T. bulbivorus* is clearly delineated, that *G. idahoensis* from *T. townsendii* is fairly distinct, and that the greatest overlap between taxa is shown for *G. shastensis* and *G. hueyi*, the two species from *T. bottae*.

The males of the *oregonus* complex will key to couplet 39 of the key to males by Price and Emerson (1971). From there they may be identified by the following modifications:

39. Outer pair of genital sac spines deeply indented anteriorly, with apices extending nearly to anterior margin of medioanterior pair (Fig. 12); usually head width at least 0.435 and endomeral plate width over 0.085; on *Thomomys bulbivorus* .... *oregonus* Price and Emerson

– Outer pair of genital sac spines not so deeply indented, with apex of at least 1 spine displaced posterior to anterior margin of medioanterior pair (Fig. 13–15); usually head width less than 0.435 and endomeral plate width not over 0.085 ..... 39a

39a. Outer pair of genital sac spines arranged symmetrically and displaced from medioanterior pair (Fig. 13); often with only up to 14

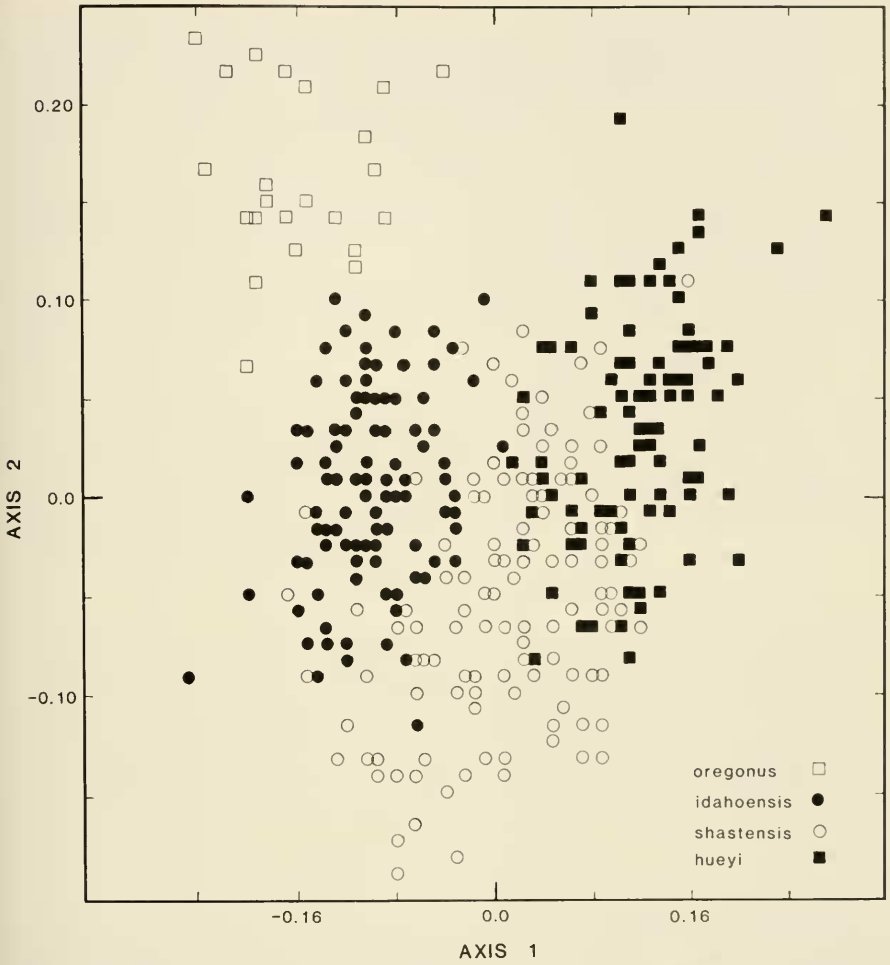


Fig. 19. Scattergram of principal components axes for *Geomydoecus oregonus* complex females.

setae on sternite III; on *T. townsendii* ..... *idahoensis* Price and Emerson

– Outer pair of genital sac spines either arranged asymmetrically (Fig. 14) or situated close to medioanterior pair (Fig. 15); often with over 14 setae on sternite III; on *T. bottae* 39b

39b. Outer pair of genital sac spines arranged distinctly asymmetrically and distant from medioanterior pair (Fig. 14); endomeral plate shaped as in Fig. 10, usually without narrowed posterior tip .... *shastensis*, new species

– Outer pair of genital sac spines arranged symmetrically and close to medioanterior pair (Fig. 15); endomeral plate usually with short narrowed posterior tip (Fig. 11) ..... *hueyi*, new species

The females of the *oregonus* complex will key to couplet 40 of the key to females by Price and Emerson (1971). If, at that level of the key, one will renumber the last two couplets from 40 and 41 to 41 and 42, respectively, and remove both *oregonus oregonus* and *oregonus idahoensis* from them, then identification may be made as follows:

40. Genital sac with flattened loops or lines across anterior half (Fig. 16–18) 40a
– Genital sac loops deeply curved 41
40a. Temple width usually at least 0.465; often over 21 setae on subgenital plate; on *Thomomys bulbivorus* ... *oregonus* Price and Emerson
– Temple width usually under 0.465; often not over 21 setae on subgenital plate 40b
40b. Usually only up to 14 setae on each of sternites III-IV; on *T. townsendii* ..... *idahoensis* Price and Emerson
– Usually 15 or more setae on each of sternites III-IV; on *T. bottae* 40c
40c. Genital sac often as in Fig. 17, with only up to 9 transverse lines or loops, these not extending to anterior sac margin; posteriormost loop not over 0.075 from anterior margin .. *shastensis*, new species
– Genital sac often as in Fig. 18, with more than 9 transverse lines or loops, these extending to anterior sac margin; posteriormost loop over 0.075 from anterior margin ..... *hueyi*, new species

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